

Inherent Weaknesses of Transportation System in Dhaka Metropolitan City and Challenges for Sustainable Development

S.M. Sohel Mahmud¹, Dr. Md. Shamsul Hoque² and Abdus Shakur Qazi¹

¹ Research Assistant, Accident Research Institute (ARI),
BUET; smsohelmahmud@gmail.com & shakurqazi@yahoo.com

² Professor, Department of Civil Engineering, BUET; shoque@ce.buet.ac.bd
Bangladesh university of Engineering and Technology (BUET), Dhaka

ABSTRACT

Dhaka is the capital of Bangladesh and the nation's gateway, as well as face of the country, has now been turned into the 26th Mega City and 10th most populous city in the world. The city experiences the proliferation of scattered development without appropriate guidance resulting in urban system difficulties. The lack of integration between land-use planning and transportation system has resulted in uncontrolled and unplanned development, non-compliance and a poor mix of land uses leading to inefficiencies in the Dhaka's transportation system. Continuous focus on road based network system has weakened potentials and attractiveness of other types of transportation system like rail or water transport. Indeed, the amount of road network (only 6 percent), accessibility, efficiency is far less than the minimum requirement (about half of the area has reasonable accessibility). The unplanned and haphazard orientation of road network also leads to built-in problems on the operational and management aspects of the transportation system and functionally weakens the entire street network performance.

Immense densification and mushrooming development of residential, commercial and other infrastructure, trims down the opportunity to construct new road infrastructure or introduce modern system for improving overall transportation system. Incomplete understanding of the inherent weaknesses of the city, the authorities are providing piecemeal solution without a long term vision which is becoming an extra burden on the overall system of the city and the city is developing with a decant growth. In this paper, an attempt has been made to point out the inherent weakness of Dhaka Metropolitan city in particular relation to transportation system and identifies some of the forthcoming challenges for sustainable development. At the very outset of the paper, a brief outline of the existing land use and transport scenario and detailed quantitative analysis with accessibility and functionality of the existing road network has been presented.

1. INTRODUCTION

Dhaka City, being the administrative, commercial and cultural capital of Bangladesh nation's gateway, as well as face of the country has now been turned into 26th Mega City and 10th most populous city of the world. Entire socioeconomic development and poverty reduction of Bangladesh is largely depends on Dhaka city. Dhaka city is the centroid of major national and international (based on Bangladesh) activities. It is the nerve center of the country and focus of all major activities.

Urbanization in Dhaka is essentially a process of migration from rural and smaller towns. After the liberation of Bangladesh in 1971, the development processes of Dhaka City rapidly increased. Dhaka City has also been witnessing a tremendous growth in population and physical expansion. The population of Dhaka has grown from only 3.4 million in 1951 to 10.71 million in 2001 – a growth of 7.31 million in 50 years (GOB, 2001). As per future prediction, this population will further grow to about 20 million by the year 2020 and to 25 million by 2025 (STP, 2004).

The city experiences the proliferation of scattered development without appropriate guidance which resulted in huge urban system difficulties. In 1959, a partial master plan was prepared for the city but the city has been developed with the minimum assistance of that plan. Even, the fringe areas of the city are progressing without any guidance, control and regulation yet which will be one of the main integral parts of the city in the near future.

At present, Dhaka city is axially expanding in the north-south direction, mainly north direction for the causes of marshy land in east-west fringe area and riverine flood flow land in the south. Sporadic residential, commercial and other socio-economic infrastructures like super markets, high-rise buildings or apartments/complexes, garments factories etc. are being constructed at various parts

of the city without appropriate consideration of planning principles, resulting in disciplined trip generation. Unplanned mixed land use pattern, presence of cantonment, BDR, airport within the core area of capital city, heavily centralized government frame structure are directly and indirectly affecting the entire transportation system of the Dhaka city. Inefficient and malfunctioning traffic management is also one of the major problems of Dhaka city transportation system, which is highly responsible for making the existing system more unproductive. Indeed, for the causes of unplanned and non-integrated road network development, there have very limited scope to apply traditional low cost but very cost-effective traffic management measures.

Crisis in the transportation system has considerably affecting the physical form and functional performance of the city. It is progressively deteriorating the entire social and physical environment causing suffering and inconveniences to the people. With ever growing increasing travel demand resulting from phenomenal growth of urban population as well as high densified land use pattern, it is a great concern and required urgent attention to prepare Dhaka city as a sustainable mega city. But for the misunderstanding of the factual and root causes of the problems of Dhaka city, every uncoordinated approach whichever is taken for improving the condition is pushing the city in worse condition gradually. Most of the improvement initiatives are undertaking considering mainly the short term need without any long term vision, which often becomes an extra burden or constraint to the city's overall transport infrastructure development potential. However, there is a need for undertaking comprehensive study to realize or identify the root causes of the problems and inherent weaknesses of the city relating to the land use and transportation system. In view of the above, a comprehensive study has been carried out by the authors in order to identify the inherent weaknesses as well as the forthcoming challenges for sustainable development of the city by analyzing most of the interrelated fields of urban land use and transport system. This paper is the review of that study containing some of the major findings related to the land use and transport system.

2. BRIEF DETAILS OF DHAKA METROPOLITAN CITY

Dhaka, the capital of Bangladesh is located at 23°42'0"North and 90°22'30"East. The area of the city is 153.84 sq. km (59.4 sq mi) in City Corporation and 590 sq. km (227.8 sq mi) in metropolitan and the populations are 6,737,774 and 12,295,728 respectively in 2007. The literacy rate of the city is about 63% and almost 50 percent of the city population are under the poverty incidence. The average household income: Low- Tk15, 000 (\$253) and High- Tk55,000 (\$920) per month and the per capita income is 550 US dollar. There are 4,12,540 registrar motorized vehicles with 1,05,636 registrar motor car. The level of motorization in the metropolitan area is 33 and car ownership level is 9. Besides, there are about 500,000 registered rickshaws in the city. The actual number of rickshaws would be two to three times higher than the registered rickshaws. Every year almost 400 persons are died by road traffic accident on the city street and almost 80 percent of them are pedestrian alone. (BBS, STP, Wiki pedia, Police report).

3. HISTORICAL DEVELOPMENT PATTERN OF DHAKA METROPOLITAN CITY

Dhaka has grown from a small settlement within the confines of the river Buriganga and Dholai Khal to to-days mega city. The physical features, topography and demographic features of Dhaka City have always influenced its physical expansion. During the Mughal and British regime, political importance and trade played significant roles in the city's growth and expansion. The historical development of the Dhaka city can be under five major periods: Pre-Mughal (before 1604), Mughal (1604-1764), British (1764-1947), Pakistan (1947-1971) and Bangladesh (after 1971).

Sequential maps (Figure 1) show urbanization as a static pattern that changes with each time period that is mapped. Figure 1 shows the growth and expansion of Dhaka City in the scale of time under five major periods: pre-Mughal (before 1604), Mughal (1604-1764), British (1764-1947), Pakistan (1947-1971) and Bangladesh (after 1971).

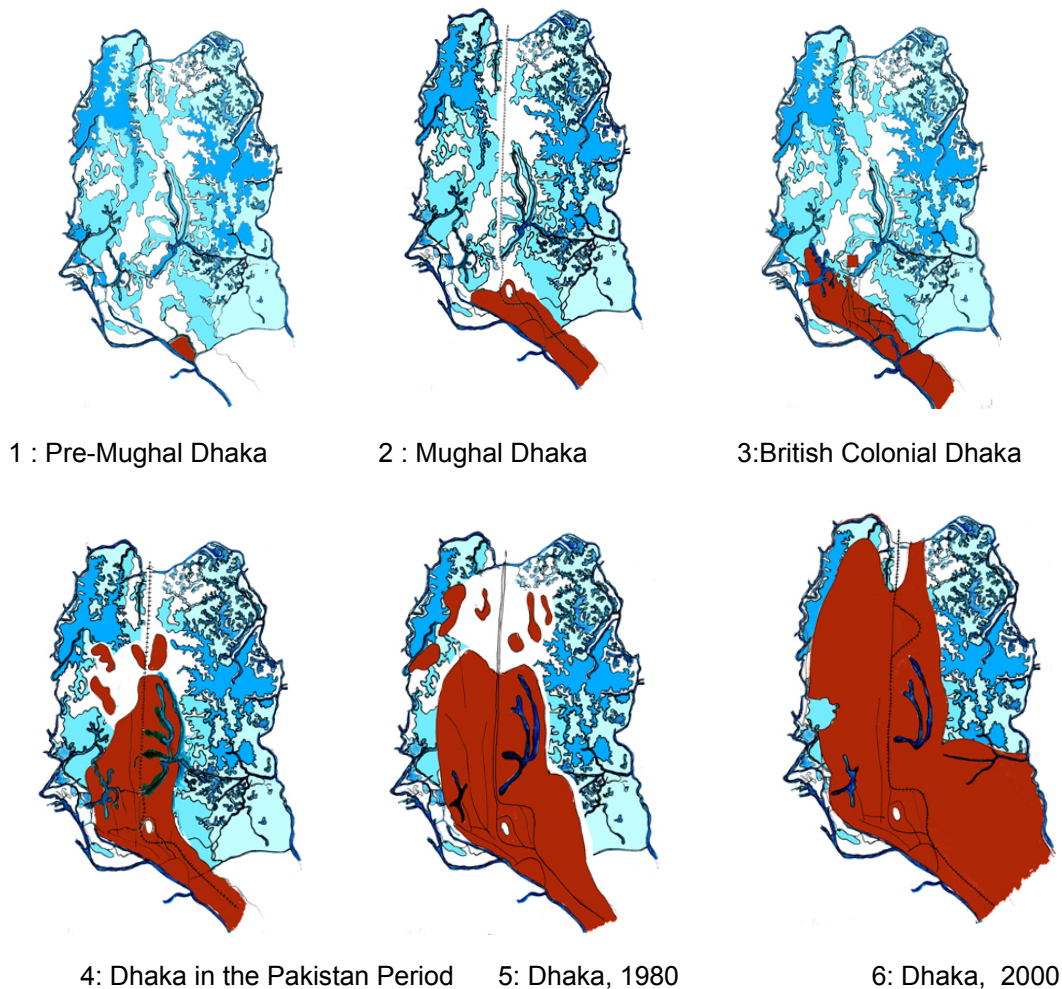


Figure 1: Growth and expansion of Dhaka City (Hafiz, 2002)

Historical urban development pattern of Dhaka City gave rise to mixed type of high density land uses with multiple major centers of activities which produces numerous short trips. The city's history as an urban center dates back to the era of the Mughal Empire. Major development of the city has been taken place in the twentieth century and its development in this century can be characterized as comprising three stages. For most of the first half of the century, Dhaka developed originally from the banks of the Buriganga River at present Old Dhaka. It was mainly limited to the southern side of the railway line. The main post residential areas were Wari, Gandaria and areas surrounding the then municipal office.

After partitioning of the India from the British Empire, new development followed a formal plan through strong government intervention. Initially the government started construction of office buildings and residential buildings to accommodate its officials of a provincial capital. This area is to the north of Old Dhaka and can be readily identified as the business district of Motijheel, the industrial one of Tejgaon, the government office precincts and the University precincts.

In fifties, the government developed the first residential area in Dhanmondi which is called Dhanmondi Residential Area (DRA). Later on the other areas namely Lalmatia, Mohammadpur, Mirpur areas were also developed as residential areas. Most of the houses built in these residential areas were one, two or maximum three storied. The then Dhaka improvement Trust (DIT) now called RAJUK developed other residential areas as Gulshan, Banani, Uttara etc. in seventies and eighties.

For last few years RAJUK has been allowing construction of six storied houses in the areas like (Gulshan, Banani, Uttara, Lalmatia, Mohammadpur, Mirpur, Dhanmondi residential area etc. For other private residential areas, RAJUK has been allowing construction of 18-20 storied houses without considering availability of existing transport or other utility services compared to the increased population in those areas.

Over the last decades the development of the city dictates haphazard growth continually and deteriorates the organic composition of the capital. The once low-density planned residential areas are undergoing rapid redevelopment to population densities many times higher than those intended in the original plan & a lot of major business and commercial districts have been developed throughout the city that draw scattered travel demand causing numerous short trips. The mixed land use pattern of the city also imposed NMT's particularly rickshaw which is one of the major problems of the transportation system.

4. EXISTING LAND USE SCENARIO OF DHAKA METROPOLITAN CITY

Surveys conducted in 1991 by the Japanese International Cooperation Agency (JICA) produced a land use map of the 265-sq. kms of the Dhaka Metropolitan Area. The studies showed that only 19 percent of Dhaka City's land was used for residential purposes, 8 percent on commercial and industrial usage, 11 percent for roads and other categories, 4 percent for village settlements, 45 percent for agricultural usage and a further 14 percent of the capital is occupied by water (GOB, 1991); only 39 percent of the city's land was urbanized while the rest 61 percent was used for agricultural and non-urban rural usage.

Urbanization in Dhaka is essentially a process of migration from rural and smaller towns. After the liberation of Bangladesh in 1971, the development processes of Dhaka City rapidly increased. Dhaka City has also been witnessing a tremendous growth in population and physical expansion. The population of Dhaka has grown from only 3.4 million in 1951 to 10.71 million in 2001 – a growth of 7.31 million in 50 years (GOB, 2001) and its share of national urban population was 25% in 1981, 31% in 1991 and 34% in 2001 respectively. The population of the city grew at an alarming rate and unprecedented way, from 1974 to 1981 become more than doubled and 53% increased during 1981 to 91 inter censal period and this rising volume was marked by the physical expansion of the city by inclusion of fringe areas. The population of this megacity is estimated to be 126.19 million by 2006 and 155.69 million by 2016 (DMDP, 1995). As per future prediction, this population will further grow to about 20 million by the year 2020 and to 25 million by 2025 (STP, 2004). Two-thirds of the population increase over the past decade has been accommodated at higher densities in established urban areas, and only one-third through new land development. As a consequence, pressure on existing services in established urban areas is increasing as densities increase.

With the development of the city, wide roads and other paved areas replaced the unpaved areas, natural depressions, and agricultural land. In many cases, natural drainage canals and open water bodies were filled up for development works. However the present status of Dhaka city demonstrates that the development of the city did not succeed to fully meet the requirements of a mega city. Absence of adequate parks, open water bodies, and drainage system has degraded the quality of living in the city in many ways. The present type of land uses of the greater Dhaka city include residential 32%, commercial 4%, agricultural 57%, water bodies 5%, and open fields 2% (Hafiz et al., 1997). However, in the metropolitan city area, the percentage of the open space, water bodies as well as agricultural land is much lower.

5. ROAD NETWORK DEVELOPMENT

The development of the existing road network in Dhaka is an amalgam of actions and inactions that have evolved over a long time in distinct and often disparate ways that prevailed at such times.

Prior to 1864 the roads of Dhaka had no names. Only mohallas had names, such as Kasaitoli, Patuatoli and Mughaltoli. It was only with the establishment of the Municipality in 1846 that the roads in this town began to be named. In 1961-62, there was a total of 110 miles of municipal roads of which 44 miles were tarred or cemented, and 50 miles brick metalled, and 16 miles kutcha fair weather roads. After the partition in 1947, Dhaka became the provincial capital of East Pakistan. Size and population of the city increased rapidly. Thus a faster vehicle, rickshaws, was introduced. Through some motorcars were available at that time, they were few in numbers. "Privately owned bus system was introduced in the city in 1950. This was insignificant to meet the demand of the people. Thus the government introduced EPRTC (East Pakistan Road Transport Corporation) in 1961. The combined fleets of EPRTC and private buses were operating in the following routes, Sadarghat-Rampura, Gulistari-Banani, Gulistan-Mirpur, Gulistan -Deinra, Gulistan-Mohammadpur. Later routes like Gulistan-Adamjee and Gulistan-Agargaun were introduced. (Firdous, 1984).

The war of Liberation in 1971 caused huge damage to the fleet. After the independence, city size and population grew in an unprecedented speed. All types of vehicles increased very rapidly

particularly public transport like bus. Transport system gradually turn on road based and demand on road network increases rapidly. But with the increasing demand, planed road network was not expanded to fulfill the requirement.

6. PREVAILING TRANSPORT AND TRAVELING SCENARIO IN DHAKA METROPOLITAN CITY

An assessment of the existing urban transport system of Dhaka revealed that it suffers from major constraints such as fragmentation of organizational responsibility; inefficient regulatory frameworks; insufficient financial resources; poor allocation of road space; presence of too many low capacity and slow vehicles on major roads; poor traffic control, management and enforcement; underdeveloped public transport system; absence of adequate pedestrian facilities; poor linkage between land use planning and transport development and finally, lack of emphasis on environmentally sound and sustainable transport development.

Various surveys (STP 2004, DITS 1994, JICA 1991, JBIC 2000 etc.) undertaken and their analysis revealed the following information about the city:

- The average household income in 2004 was Tk15,000 (\$253) per month while 3½% of households was in the “high” income group exceeding Tk55,000 (\$920) per month (STP 2004);
- The average number of persons per households in 2004 was 4.12 (STP 2004);
- Among households 7% either have or have access to a car, 4% owns motorcycle, 3% cycle rickshaw, 5% bicycle and 2% auto-rickshaw (STP 2004).
- Almost 84% of household do not have any sort of transport vehicles and depend on public transport and only 16% have some sort of vehicles (STP 2004).
- Among the important purposes (i) home-work 31%, (ii) home-education 25%, (iii) home-shopping and others 36%, and (iv) non-home based trips 8% (STP 2004).
- On average, each household undertook 8½ trips per day by all modes (STP 2004);
- At present, the number of trips that are generated per day is 21.98 million and after 20 years, the trip generation per day that is estimated is 159.63 million in 2024 (STP 2004).
- The average trip length was found to be 5.37 kilometers (STP 2004).
- Buses comprise a small proportion of vehicle numbers (11½%) but carry about 77% of people (STP 2004);
- Rickshaws comprise 28% of all vehicles moving in the city and forms primary travel mode for 34% of all person trips (STP 2004);
- Proportion of trips made by walking is substantial, though according to STP around 22%, DITS estimated that 62 percent; and
- Road space occupied by rickshaws is 73%, and by cars, buses and tempo is 19.7%, 4.4%, and 0.4% respectively (DITS, 1994).
- Among the modes, car occupies the highest space for carrying a person which is 75.8%. Rickshaw occupies 21.9%, Baby taxi 17.9%, bus 8.7% and tempo 5% (STP 2004).
- Autos are a low proportion of vehicles comprising less than 10% of travel;

7. EXISTING ROAD NETWORK OF DHAKA METROPOLITAN CITY

An important part of every town is its transport system and particularly its road system for affecting smooth and efficient movement of people and commodities. For good accessibility, the circulation system of a city should meet certain basic requirements. Firstly, the vehicle users should be able to move from one part of the city to the other easily, safely and efficiently. Secondly, the roads should be arranged so that they provide adequate access to every building for vehicles and pedestrians. To meet all these requirements a system of hierarchies in the road network is required, and this hierarchy results in a system which is composed of various types of roads designed for different types of movements according to the function, character and volume of traffic. A well-articulated road network system usually occupies 20 to 40 percent of urban area depending upon the size, function and character of the city. (Choudhury, 2001). There are only 9 percent of the total area are road space where's pavement space only 6 percent in the DCC area of the 1286 km of road comprising 61 km primary, 108 km secondary, 221 km connector, 573 km local and rest narrow road (Table 1).

Table 1: Different Types of Road Length, Pavement Area and Road Area of DCC

Classes of road	Length (km)	Percent	Pavement area (sq. km)	Percent	Percent of total land area	Road area (sq. km)	Percent	Percent of total land area
Primary	61.45	4.78	1.46	16.47	1.08	1.89	15.67	1.41
Secondary	108.20	8.41	1.86	21.05	1.39	2.41	19.94	1.80
Connector	221.35	17.21	1.68	19.04	1.25	2.47	20.42	1.84
Local	573.75	44.61	2.93	33.17	2.18	4.25	35.19	3.17
Narrow	321.27	24.98	0.91	10.28	0.68	1.06	8.78	0.79
Total	1286.02	100.00	8.84	100.00	6.59	12.09	100.00	9.01

Source: RMMS (Analyzed by Author)

In further analysis, it is found that there are only 107 kilometers road which width more than 24 meters in all over the city of Dhaka among the total 1286 km road. Indeed, there are only 45 km of road which pavement width more than 24 meter. Indeed, among the total road of the Dhaka City Corporation area, 821.61 (64%) km road width is more or equal to 4.75 meter but according to pavement width, that's are only 618.14 (48%) km. So, although 203 (16%) km road width is more or equal to 4.75 meter but their pavement width is less than 4.75 meter, i.e. emergency vehicle could not be entered that pavement width road. So, this 203 km road could be made accessible by increasing the width of pavement of the road. But, other 464 (36%) road pavement width could not be increased without demolishing existing road side development as road entire road width is less than that the desired level of accessibility but that's are almost impossible as this problem is started from very beginning of the planning of the city and both side roads is highly buildup by multi-storied building and huge densified with about 0.1 million people per sq. kilometer. On the other hand, a city could not sustain with this huge amount of so thin vein which is totally blocked or plugged or out of use.

In further analysis, it is found that there are only 2.15 km of road is available for 10,000 of population and pavement space available only 0.015 sq. km. The availability of major roads in terms of either km per thousand populations or km per square kilometer of area is too low as compared to the other cities of developing countries. According to the world bank statistics in the report on road per capita in 9 cities of developing countries and 26 cities of developed countries is 0.5 and 4.5 meter respectively (Ingram and Liu , 1998). Whereas, in Dhaka City Corporation area, per capita road only 0.0213 meters is available. This scarcity of the road length or area will be sustaining until the city remain. That's this is one of the fundamental inherent weakness of the city of Dhaka for their yield land use and transport panning.

From the above discussion and facts, it is found that the existing road in the entire city road network is not quite enough and is the one-fourth of the minimum requirement of a modern city. Even, after the implementation of newly developed Strategic Transport Plan (STP), total road network would be around 1413.67 km and road and pavement area would be 15 (11%) and 11 (8%) sq.km respectively. Besides this, the roads which are existing are not proper functioned and are not fully operational with full capacity for the causes of huge alignment, layout or orientation problems of the entire road network.

8. INHERENT WEAKNESSES AND CHALLENGES

Proper land use and transport planning, adequate well oriented functional road network and optimum operational capacity is the key elements of the sustainable, safe, efficient transport system of a city. Ensuring of this system is now become a great challenge in the Dhaka Metropolitan City for the immense land use and transport planning, road network and functional and operational inherent deficiencies and weaknesses. Some of these weaknesses as well as challenges for sustainable development to cater with the forthcoming demand are listed below:

8.1. Land use and Transport Planning

Population Growth: Dhaka City has been witnessing a tremendous growth in population and physical expansion. Urbanization in Dhaka is essentially a process of migration from rural and smaller towns. After the liberation of Bangladesh in 1971, the development processes of Dhaka City rapidly increased and the population has grown very fast and the forefather of the city or city authority could not predicate the population of the city will jump in such dramatic way. The great example of that is the master plan of 1959 which was developed assuming 1.75 percent of annual growth rate of

population but actual growth rate of the city is almost three and half times higher than the assuming rate (8 percent per year). The accommodation and shelter facilities did not grow with the growth of population results haphazard and unplanned colossal densified development of the different areas of the city to survive in the limited areas.

Development and Impact: Urban land use planning and policy, integrated and co-ordinated transport network development, protection of environmentally sensitive areas, are the issues discussed only in seminars and research papers but unfortunately very little practical measures have been under taken to provide integrated and efficient transportation facility, safeguard ecologically vulnerable areas and to control development of the mega cities. As a consequence, city is expanding in an unplanned and uncontrolled way with haphazard land development, destroying natural flood plains, depression areas for storm water drainage canals, even the encroachment of river is taking place. Out come of such reckless conversion of urban land results unrecoverable default land use, non-integrated transport transportation network, huge traffic operational and management disturbance, in frequent and devastating flood, water logging, reduction of ground water recharge area, destruction of recreational and scenic areas and loss of biodiversity with intolerable traffic jam. Whenever there is no comprehensively planned development of a city and all the development is controlled by speculative motives. It is obvious that the present lopsidedness of land use reflects the inequality of the existing socio economic structures. These conditions are doubly highlighted when one see a vast number of city dwellers are living in slums and hovels, multistoried or otherwise, within the city limits

Regulate and Control: Though several planning documents have been prepared to regulate and control development but in reality the application and execution of the proposed policies is not worth mentioning. Failure of government intervention to guide and control land development process is primarily responsible for uncontrolled conversion of wetland to urban use. The other problem is that if a city does not grow according to a guideline, then the whole system gradually collapses. Political interference happens everywhere but here it has descended to the level of greed. This is unwanted but real facts for whole of the city and at present the problem is irreversible.

Fringe Areas: Large portion of the fringe areas are growing by private individual initiatives without following any plan and regulations. In this process private sector played the dominant role while public sector limited itself to infrastructure development and service provision. However, growth of large sections of Dhaka by private individual initiatives has taken place in an unplanned manner due to absence of proper guidance by the concerned authorities.

Road Development: The development of the existing road network in Dhaka is an amalgam of actions and inactions that have evolved over a long time in distinct and often disparate ways that prevailed at such times. Unfortunately, most of the major roads and road infrastructure of the city developed by executive order by army government as a piecemeal solution, not to following the long term master. Even, the road which has been constructed by executive order, that roads are not properly functionally maintained. So, overall development of the city as well as the transport network progress in fully wrong way and at present the city come to extreme level from where undo is almost impossible.

High Buildable Land: From the historical satellite image, overall observation and the description of the master plan, it is found that the first and foremost problem of Dhaka city is the shortage of suitable buildable high land, free from annual flooding, on which to build; this applies to both Dhaka and Narayanganj which is also argued in the first master plan, master plan for Dacca 1959. So, it can be say that the selection of this topography for a capital city was not fully appropriate decision particularly in considering the present condition.

Topography and Consequence: The elevation of Greater Dhaka is 2 to 13 meters above the mean sea level (msl) and most of the urbanized areas are at elevation of 6 to 8 meters above the msl. The land area above 8 meters msl covers about 20 square kilometers. The land ranging from 6 to 8 meters msl covers 75 square kilometers while 170 square kilometers of Greater Dhaka is below 6 meters (JICA, 1991). Due to such low topographic condition, most of the lands of the city are low land causes huge scarcity of build able land. As, most of the area are below the natural water level, pre-planning of land and control of development for urbanization is really impossible results unplanned, ad-hoc development with narrow, zigzag road network on donated land and consequently uneven city size. Besides, the rainwater cannot smoothly discharge to the lakes, khals, retention areas and

surrounding rivers and the accumulated runoff remains stagnant in low laying areas inside the city and creates serious flooding of the city and severe water logging problem results disruption of traffic movement, disruption of normal life, damage of road infrastructure, damage of structures, huge water pollution, increase of water born diseases, breeding site of mosquito, damage of vegetation and reduce aquatic habitats, increase of construction and maintenance cost, shortage of drinking water, loss of income potential, and huge and sustain economic losses for flood and for the flood protection.

Master Plan and Outcome: and 'Dacca Master Plan' was formulated in 1959, considering the city as a provincial capital. 'Dacca Improvement Trust' was established to materialize the plan. Even though the plan could not be implemented this created an open opportunity to develop the city without prior supervision of city planning experts. Due to inadequate government intervention and major share by private sector entrepreneur in the physical development of the city, serious system deficiency have been observed in the land use pattern of the city. After independence, some contemporary plan came like Dhaka Metropolitan Development Plan (1995-2005). But no such significant measures have been taken according to the plan. As a result, Dhaka grows without distinctive land use zones (such as Residential, Commercial, Industrial estate etc.) with very few exceptions as discussed earlier. For the causes of deficient development pattern results unplanned and haphazard road network, uncontrolled changes of land use pattern with different time, conversion of planned residential area, death of Dhaka's posh spots, indiscriminate and unexpected road side garments industries, losses of wet land of the city, losses of open space, greeneries in city areas, disturbance of ecology and biodiversity, disappearance of natural drainage system, encroachment of drainage channels and retention ponds, decrease of ground water recharge area and ground water level, unacceptable water, air and other pollution, losses of water runoff area, shrinking of retention pond and sustain and continuing financial lose. These misfortunes create incompatible living and working environment for the city one side and also deteriorate transport condition influencing random traffic generation.

Access: In Dhaka metropolitan city, there has not any rule or regulation to control the direct access in the different classes of road. People are frequently connected their buildings/ abating properties with the main road through direct access road, even with the principal arterial road. Most of the multi stored building are erected violating the set back rules particularly after independence. Buildings are built just adjacent to the roadside boundary leaving no space and even parts of the building are extended over the streets in many cases. Even, so many multi-stored commercial building is buildup without any frontage space, proving sufficient setback for walking, parking etc.

Road Side: Most of the development is progress in the city only on the road side base. As, there has not any regulation to control access of the road, most of the plots adjacent the road were developed without considering any access facilities for rear side properties and series of huge number of multi-stored buildings, markets and shopping centers have been developed at the very near to roadside without considering the resulting impact on the functionality of the road. Even, a similar situation is seen in every busy street in the sprawling capital city of more than 10 million people. Indeed, multistoried shopping malls are coming up almost every month, turning the city into a huge bazaar.

Junction Corner: Junction corner point which is most complicated zone of the road network is developed without considering turning space as well as future expansion provision for grade separated facilities. Even many roads are ended or change direction for the construction of multi-stored build ahead of its alignment results the capacity of the junction reduced and future improvement options have been condensed for ever.

Level Crossings: Unacceptable railway level crossings run through the Dhaka city creating interruption during passage of train on both side of rail gates for one an average of 4 (four) hours in each day. Suspension of traffic flow due to closer of rail gates serves to compound the prevailing chaos.

Functional Efficiency: Most of the development of the city took place by sprawling and scattered way and there has very little linkage between the activity areas and the ease of movement. However, most of the case the city dwellers requires more effort, more time as well as more cost to perform in the city area. That's way; it is evident that, the city is not functionally efficient.

8.2. Road Network

Alternative for Movement: Dhaka mainly depends on road-based transportation network system. Road bias has been evolved due to topography of the city, technical advantage, past network development trend, availability of foreign aid etc. Continuous focus on road based network system has weakened potentials of other types of transportation system like rail or water transportation system. Hence there is no such inter-linked and mutually dependent multi-network system for Dhaka Mega City. As a result, no other alternative for the movement of people and goods can be found to meet increasing and diversified demand of the urban community. The situation becomes worst in case of any disruption of road network, particularly the major links of the City.

Road Amount: From the analysis of road network database, it is found that the total road length in the DCC area is 1286 km comprising 61.348 km, 116.404 km, 219.543 km, 569.868 km, and 318.271 km of primary, secondary, connector, local and narrow roads respectively. The total area of these five types of road is only 12.09 sq. kilometer among them 8.84 sq. kilometer is pavement area which are respectively 9.01 percent and 6.59 percent of the total land area of the city. It is argued that an ideal city should have 25 percent of road; where as in this city has only quarter percent of that desired level. There is a very few provision to increase the road area of the city without destroying the road side development. That is very difficult and would be huge burden of our fragile economy. So, this scarcity of the road length or road area would be sustaining until the city remain. That's this is one of the fundamental inherent weakness in the city of Dhaka which also results from unplanned and haphazard land use and transport planning.

Multi-lane Road: There are only 107 kilometers road which width more than 24 meters in all over the city of Dhaka among the total 1286 km road. Indeed, there are only 45 km of road which pavement width more than 24 meter. In the zone number 2 and 3, there has not even 1km of road which width are more than 24 meters (0.31 and 0.59 km according to road width, 0.31 km and 0.00 according to pavement width respectively). It is found that there are very few road which pavement width even road width is more than 24 meter width that's more than 6 lane. So, it is highly difficult to provide separate lane for rapid mass transit like BRT.

Accessible Road: In Dhaka city, about half of the roads are not sufficient width from where a motorized vehicle can move among the existing road. Indeed, among the 1286 km of road of the Dhaka City Corporation area, 821.61 (64%) km road width is more or equal to 4.75 meter but according to pavement width, that's are only 618.14 (48%) km. So, although 203 (16%) km road width is more or equal to 4.75 meter but their pavement width is less than 4.75 meter, i.e. emergency vehicle could not be entered that pavement width road. So, this 203 km road could be made accessible by increasing the width of pavement of the road. But, other 464 (36%) road pavement width could not be increased without demolishing existing road side development as road entire road width is less than that the desired level of accessibility but that's are almost impossible as this problem is started from very beginning of the planning of the city and both side roads is highly buildup by multi-storied building and huge densified with about 0.1 million people per sq. kilometer. On the other hand, a city could not sustain with this huge amount of so thin vein which is totally blocked or plugged or out of use.

Accessible Road Area: In terms of area of those roads, there are only 10.51 sq.km (7.83%) road area or 7.38 sq.km (5.49%) pave areas of roads which road width is more than 4.75 m or can be treated as accessible road. Though, the total pavement area of the city is 6.59 percent, but the functional pavement area of the city only 5.49 percent. But considering the pavement width, there are only 7.1 sq.km (5.3%) road area or 6.6 sq.km (4.9%) pave areas of roads which pavement width the more than 4.75 m or can be treated as accessible road. Indeed, according to the pavement width base analysis, there are only 4.9 percent of road which pavement width is more than 4.75 m and it can be say that in the city there are statistically only 4.9 percent of road which is fit for vehicle operation.. In the zone 1, 2, 3 and 7 more than 50% road width is less than 4.75m.

Per Capita Road: In further analysis, it is found that there are only 2.15 km of road is available for 10,000 population and pavement space available only 0.015 sq. km. The availability of major roads in terms of either km per thousand populations or km per square kilometer of area is too low as compared to the other cities of developing countries. According to the world bank statistics in the report on road per capita in 9 cities of developing countries and 26 cities of developed countries is 0.5 and 4.5 meter respectively (Ingram and Liu, 1998). Whereas, in Dhaka City Corporation area, per

capita road only 0.0213 meters is available. This scarcity of the road length or area will be sustaining until the city remain. That's this is one of the fundamental inherent weakness of the city of Dhaka for their yield land use and transport planning.

Road Widening: The existing road in the entire city road network is not quite enough and is the one-fourth of the minimum requirement of a modern city. Even, after the implementation of STP, total road network would be around 1413.67 km and road and pavement area would be 15 (11%) and 11 (8%) sq.km respectively. Obviously, it is the very lower than the minimum standard of a modern city. Unfortunately, there has not any option to convert a narrow road to an accessible road by widening the road as both sides are highly buildup without any setback. Indeed, most of the narrow roads are not sufficient width in which three wheeler non-motorized vehicles like rickshaw can enter and it is almost impossible to widen and extended of that roads as most of the areas are highly buildup. So, this inaccessibility will be sustained of the city as a patient who has not any medicine for treatment and going to certain death. There are many narrow roads where indeed sunlight can not fall and remain dark and marshy in all time. For the cause of high construction on both side of that road, the improvement of the geometric condition by widening of the road or by any means is almost impossible and this weakness will have to sustain everlasting the city.

Sustainability of the City: A city could not livable as well as functionally efficient with these huge amounts of damaged or useless vain. The flow of the city is blocked in every side of different land areas in different parts and becoming blue/pale face as a part of a human body whose blood circulation has been blocked and sensitivity has been lost and once upon a time it is affected the entire body. So, the city is becoming such a patient who will eventually die for the lack of blood circulation. Therefore, the only solution is the abandon of the city.

Alignment of Roads: Besides this huge scarcity of the road network, the existing roads are not proper functioned for the causes of enormous alignment weakness viz. no road network pattern, default road orientation at micro/local level, un-organization and non-integration of road network, no bypass, ring or functional arterial road, no alternative corridor to connect the other part of the city, no east-west continuous road, huge missing link, staggered & T-junction, no classical and functional hierarchy, discontinuity of the main road.

Layout Plan: The layout of major roads e.g. primary, secondary and tertiary are neither straight nor diagonal, neither grid nor orthogonal. Indeed, the primary, secondary even tertiary roads are scattered and haphazard without well-linked and functional connectivity with each other. Primary roads are separated from each other and ended by creating either a T-junction or staggered junction with tertiary road which are creating permanent bottleneck on the enter city road network. Even, no east-west, north-south straight or circular or diagonal continuous road is available in the city. Indeed, the city road network was developed without any well-defined pre-plan. Even, until today, the city is expanding without any long-term vision, following any detailed road network master plan.

Network Orientation: Road network orientation of the so called planned residential areas itself converted the areas as commercial or mixed area for its faulty planning. Indeed, this conversion problem was built-in the planning of that areas. If the road network of this area became discontinuous pattern instated of continuous grid pattern, the area would remain residential area everlasting. Therefore, this is the one of the inherent problem of the preplanned residential area of Dhaka city, which is built in from the planning stage of the city by the city planner or authorities.

Pre-planned Area: Beside this, most of the East-West roads of that pre-planned area are directly connected with the primary arterial road like Mirpur road, Airport road, Rokeya sharani etc. Each of the connecting roads formed a direct access creating T-junction with the primary road, which should have minimum access and high mobility for through vehicles mainly in Mirpur Road and Rokeya Sharani in Dhanmondi and Mirpur area. Even, there has not any provision for providing service road facility to reduce the access density. Most of the major intersections (cross two major roads) of these areas have not planned with long term vision considering future improvement options. Consequently, the productivity, capacity, potentiality of the primary arterial road will be decreasing day by day. That's, which the city has, that's are losing gradually. Unfortunately, the areas which are developing in recent period are causing similar planning problem like new DOSH.

Local Areas Road: Most of the local areas of Dhaka city, where have not any kind of pattern of road network, even many of the areas where have not any accessible path which can be defined as a road. Haphazard development with minimum accessibility road network has been developed on the donated land by the local community. These road networks are mainly superimposed on the built-in land. Most frightening is that, there has not any general solution to overcome these problems. It is also impossible to renew these areas as most of the areas are fully buildup and highly dense.

Connectivity: During last twenty to thirty years, significant road development has been taken place to cope with sudden transformation of the city from provincial town to the capital of a sovereign country. But most of the transport developments have been driven by ad hoc considerations having no explicit focus on analysis of existing demand or future requirements. As a result, the road network of the city is not organized and integrated in terms of connectivity.

Functionality and Future of the City: In the city, there has not any functional through and by-pass road, ring or distributor road, through principle arterial for inter district through traffic, alternative corridor to connect the other part of the city, proper gateway of the city, direct east-west continuous road etc. Many strategic links are missing in the network and many areas have inadequate accessibility to it. Besides, T and staggered junction, right angle bends on main road, lack of no classical road hierarchy and discontinuity of main road functionally weakened the entire road network system as well as transport system of the city. It is also so alarming and reality that, as the capacity of the nerve decreases by sedimenting cholesterol and creates heart attack, the capacity of the entire road network even so called major primary roads are decreases with the development of the city day by day and once upon a time the heart will be stopped i.e. the circulation of traffic will be collapsed and eventually the city will die.

8.3. Functional and Operational Deficiencies

Road Hierarchy: From the observation of overall city network, it is seen that there are a wide lack of classical as well as functional road hierarchy in the Dhaka city. DITS and RMMS classically divided the road of the city in five categories and definitions of each classification also provide by DITS according to some selected geometric specification not by functional or operational configuration. Indeed, hierarchical road classification made by DITS could not satisfy most of the desirable features, classification criteria and assessment factors. As a result, the road network remain without any hierarchical order and function serving the city with discontinuous and fragmented links in reality, which is the major system deficiency of transportation system of Dhaka. There is no possible way to overcome this deficiency and this inherent weakness of the city road network will be containing until the city will exist in this location without major demolishing or shifting particularly in Dhaka City Corporation Areas.

Functional Primary Road: The city has not any functional primary as well as arterial road at present. Besides this, from the overall observation, in-depth investigation on geometrical, operational and functional characteristics, it can be concluded that it is almost impossible to provide a full fledged functional primary road in the future on the existing city areas by the city authority for the city dwellers. Besides, the level of service of the major road of the city is very low, varied between D to F

Alternative Modes: The existing modes and sub-modes (bus-water-rail-NMT) are acting independently of each other. The rail system is neither a competitor nor a suitable alternative of the road based travel modes particularly in case of inner city commuter movements. On the other hand, since the proposed circular waterways are located at the periphery of the built-up areas, it is also not a viable alternative particularly at the fringe areas.

Responsibility and Co-ordination: Land use planning functions are separated from the transportation planning. Whereas RAJUK has developed the Structure Planning and is responsible for its implementation, the transportation and traffic planning functions are divided among BRTA, DTCCB, DCC, and the DMP. Traffic control and transport management are also being performed by different organizations such as DCC, DMP, and BRTA in an un-coordinated manner. There is no central database of road traffic, road incidents, registration of vehicles, driving licenses etc. which can be shared with the concerned agencies.

Private Developer and Road: Most of the property development occurred in the city by private developer. But road sector develop only by the government. So, there generate a great imbalance between the development of other sectors and transport sector. Indeed, most of the required land for road construction is occupied by the property developer like road side development, intersection corner point development, frontage development.

Low Cost Management: Transportation System Management (TSM) is a package of short term measures to make the most productive and cost-effective use of existing transportation facilities, services and modes. From this study, it is evaluated that there is very few option to introduce low cost transportation system management like one-way streets, tidal-flow operations, restrictions on turning movements, reduction of signal phases, installation of coordinated signals, restrictions on loading and waiting, exclusive bus-lane, closing side-streets in the present land use and transportation system of the mega city Dhaka and also there is not any cost effective solution to make possible for introducing such tool. This is a built in problem for the mega city of Dhaka and the city is detriment such a cost effective modern traffic management tool everlasting.

High Cost Management: On the other hand, for the causes of road side and junction corner point development, it is vary difficult to provide effective and well designed grade separated facilities in the major road and intersection of Dhaka metropolitan city. Technological measures such as intelligent/automated highway/vehicles, advanced traffic information system, adaptive traffic signal control, active marking and headlight, auto-surveillance/incident detection/enforcement measures is also difficult to implement in the present huge densified land use and transport condition of the city.

Access Control: One of the major problems of Dhaka city roads are the uncontrolled access which reduce the mobility of the road as well as entire capacity of the road is that too much access roads which are directly connected with the major road. One an average, almost one direct access road per 100 meter in each direction in the major road of the city. RAJUK provide the alignment of road but the layout of access or position of access is not identified. For the lack of proper pre-positioning of access, the owner who has plot on road side, constructs building without considering the accessibility or road connectivity of the behind communities. At this condition, the community people made connection with the main road haphazardly on the donated land.

Stopping and Parking: Due to acute lack of enforcement on illegal stopping and parking at and around intersections, a complete break down of lane discipline and overall traffic flow situation occurs, mostly beyond of control of the traffic police. Besides, inappropriate road sides land use activities, corner point development not only further decreasing the capacity of the intersection but also fully damage the future improvement options.

Road for Per Vehicle: From the analysis, it is found that there are only 4.86 meters of accessible road is available if all the registered motorized vehicles are coming on road at a time and if at least 50 percent of vehicles come into the road then they will get only 9.72 meters of road. In terms of pavement space, the available areas are 17.9 sq. m, 25.57 sq.m and 35.8 sq. m. for the case of all, 70 percent and 50 percent on road registered motorized vehicles. Where as only for resting situation at least one an average 6 to 7 meter road length and 12-18 sq. m. roads space is required (Kadiyali, 07) and for free flow condition there will required more length and space. In this situation, congestion is must and which is a real fact on the road of the city. On the other hand, every month around 3,000 new vehicles hit the road contributing to increasing burden on road and severe traffic congestion. This is also badly hampering the average speed as well as traffic operational condition of the vehicles.

Utility Service Space: Most of the road in Dhaka city has not sufficient separate road side space for utility service line, no sufficient drainage facility. Even, the width of the major road is not consistent and at present situation it almost difficult to provide more space for utility services and increase road width for the consistency of the pavement width.

Traffic Operation System: Road network of Dhaka city is characterized by mix traffic system. All types of vehicles, both motorized and non-motorized vehicles are in operation on each and every road, except some VIP routes. Almost three fourth of the road space occupied by the rickshaw (73%), followed by cars 19.7%, buses 4.4%, and tempo 0.4% . At present, rickshaws poses dominate most of the roads which one of the major weakness of the entire transport operational system particularly for the through arterial road. This problem is now become a major concern issue and becomes an

irreversible problem for the causes of yield land use and transport planning and uncontrolled development.

Road Encroachment: Encroachment of road and road side is one of the major inherent operational problems of the city transportation system because different legislations, movement, steps for removal of these encroachment became unsuccessful totally so many times, even executive order by army government under the emergency. The hazards by these encroachments hinder smooth flow of traffic and occupy almost one third of the operational space of the major road.

Cutting and Digging: Frequent cutting and digging by different agencies like T&T, WASA, Titas Gas, DESA for utility services, not only causing a horrible situation of traffic congestion for months together but also reducing structural integrity of road geometry, increase road side friction and reduces effective width of road/capacity due to low riding quality and affect wiring/detectors of signals.

Parking Facilities: Insufficient parking facilities at shopping centers as well as the commercial areas have remarkable impact on traffic flow in adjacent roadways. Though, in Dhaka Metropolitan city according to Building Code Regulations provided by RAJUK only basement base parking is mandatory, almost 12 percent of tall building (7+ floor) has not any parking facility at all. Old Dhaka like Kotwali and Lalbag thanas' almost 67 percent and 54 percent tall building have not any parking lots or facilities. Besides this, from the field observation and review of various survey reports it is found that the buildings which have underground or ground parking facilities, most of the space are used for another purpose not for parking like storage room, garage, rent for shop or hawkers, even bed room for servants etc. particularly in the busy road side multistoried market.

Parking in CBD: Parking problem of CBD, Motijheel commercial area is also great concern issue. To reduce the parking problem of this C/A, parking cum commercial multi-storied complex (city center) has been proposed and construction of this complex is already started. But, it is observed that for the causes of yield planning and design, this complex will create negative impact on the road network of this area as well as entire the city area.

Truck Facilities: In Dhaka metropolitan city, thousands of trucks entering the city have not any designated modern, equipped truck terminal or parking facility with minimum conveniences for operators, users and owners. At present for the lack of ownership on the land, it becomes almost impossible to develop a well organized truck terminal in the city area or entrance of the city.

Filling Stations: The rules for setting up filling stations in the city are being violated rampantly in matters of keeping minimum distance from the road side, between two stations, traffic obstruction safety measures. Lack of co-ordination between the Bangladesh Petroleum Corporation (BPC) and Rupantarita Prakritik Gas Company Limited (RPGCL) is create another problem on this regard. In the city, so many CNG station was constructed by earth filling of wetland, from 12 feet below the road level violating the wetland law. Gas supply for the station is one of the great problems for unplanned development of the city and improper positioning of the station. As most of spaces are congested by the urbanization of the city, there are minimum spaces for provident gas line except under the main road. As a regard, most of the station managed gas supply by cutting the main road, boring underneath the rail tracks from the supply.

Pedestrian Facilities: Analysis of data from home interview and O-D (origin-destination) surveys reveals that pedestrian is by far the largest identifiable group. Pedestrians thus clearly form by far the single largest group of road users in terms of total catered number of trips in urban areas of Bangladesh. This is particularly prevalent (about 65 percent) for short trips up to one mile. Walking as primary mode of travel is dominant in all age groups and income classes. It is most prevalent for low income groups, nearly 80 percent. Indeed walking appears to be a major contributor to a sustainable transport strategy. Yet pedestrian can still claim to be our most forgotten and neglected road user group. Pedestrians need protection in the form of facilities by ensuring their safety and convenience. But, unfortunately there is huge lack of pedestrian facilities and these limited available facilities could not used properly for the causes of ill maintenance and management.

Traffic Segregation: Because of the absence of periodic maintenance of the roads, a lot of potholes exist on the surface of the roads. There is no segregation facility between fast and slow moving and both types occupy the some carriageway. Due to the absence of physical segregation,

non-motorized vehicles usually take any position across the road way and thereby affect the mobility of motorized vehicle.

Mass Transit System: For the causes of limited road space, lack of accessible road, unplanned road network pattern, unorganized and non-integrated road network, absence of east-west continuous road, lack of continuity of main road, huge side friction, uncontrolled access, less productive intersection, lack of loading and unloading facility, inadequate bus stops, lack of bus lay on road, poor allocation of road space, deficient and improper place of bus terminal and for the lack exclusive right of way the mass transit system is not quite good and seems very difficult to improve the condition.

Functional Mass Transit: Due to the absence of bus priority measures, safety precautions, fragmented ownership, fragmentation of organizational responsibility, lack of passenger shelter, on road ticket counter, lack of integration with other mode, unscheduled, non demand responsive, lack of local accessibility, inefficient regulatory frameworks, insufficient financial resources, presence of too many low capacity and slow vehicles on major roads, poor traffic control, absence of adequate pedestrian facilities, poor linkage between land use planning and transport development and finally, lack of passenger information, lack of emphasis on environmentally sound and sustainable transport development, other various problems of bus journey functionally weakened the total mass transit system of the city areas.

Rapid Transit: In spite of having huge benefit and large potentials, there are so many conflicting and constraining issues like insufficient road width, insufficient space for BRT station, uncontrolled and excessive access road, huge pedestrian movement, huge number of bus operators, unorganized and non-integrated road network, mixed operation in major roads of the proposed route, turning difficulties of BRT bus, lack of traffic signal, lack of passenger information etc. on the existing transport system of the city, which directly conflict the implementation of the proposed Bus Rapid Transit BRT successfully. These issues not only creates question on its feasibility but also possibility at all.

9. CONCLUSIONS

Dhaka is considered as one of the densely populated mega city of the world. Since the road network system of the city is not planned or did not build to cater the needs of present days and future requirements, it becomes now difficult to upgrade roads with proper realigning or widening. Because, major portion of the roads now pass through densely populated area and numerous permanent residential and commercial multi storied buildings are constructed on both sides of the roads and the city is growing with a pattern of decant growth. For the causes of such decant growth, what we have we are loosing day by day. In other word, we do little but we are deteriorating.

This problems has expressed by a national newspaper in this way, "You are lucky if you live in Dhaka. Chances are that you'll go to heaven immediately after death, because you've already served your full term in hell right here on earth" (Financial Express 11 April 1997). One of the reasons why Dhaka is compared with hell is its transportation problem.

Indeed, at present, the city is affected as a chronic cancer affected patient whose recovery is ultimately impossible. Most of the cell are already affected and exaggerated from larger to larger with the passing time and eventually it will die. So, all the short term investment to survive this the is just to make delay of its death not to full recovery. However, so many investments could be invested, all the investment will sack by this patient as a black hole and ultimately it will die.

The short time and medium time recommendations are only for the survival of the city for few years, but not the ultimate solution of the problems of the city. The weaknesses of the city which have developed in the last 50 years stands in such a position which are irreversible and come back or renewal from this position is almost impossible.

So, like many other country of the world viz. Pakistan, India, South Korea etc. the capital city of Bangladesh should be gradually shifted to a suitable location of the country where sufficient build able land is available and connectivity with different part of the country by different modes is quite well.

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